



AS I SEE IT

Bridge over troubled water — valuing Russia's scientific landscape

Ulf Büntgen^{1,2,3,*}

¹Swiss Federal Research Institute WSL, 8903 Birmensdorf, Switzerland

²Oeschger Centre for Climate Change Research, 3012 Bern, Switzerland

³Global Change Research Centre AS CR, 61300 Brno, Czech Republic

ABSTRACT: Environmental and climate change not only implies many research needs, but also offers a wide arena for (re)activating collaborations between Russia and the international scientific community. Despite a variety of economic and logistic challenges, as well as political and administrative caveats, I advocate how to help mitigate a deterioration of the Russian Academy of Sciences, to reduce the brain drain from the world's largest country, and to facilitate access to, and the exploring of, unique paleo-archives.

KEY WORDS: Environmental change · Brain drain · Interdisciplinary research · Paleo-archives · Russia · Scientific collaboration

1. MOTIVATION AND BACKGROUND

The negative effects of a dwindling global oil price on the Russian rouble and the country's overall economy, together with increasing political isolation, cast a long shadow on Russia's international reputation, with severe consequences for its scientific community. The situation is further exacerbated by the ongoing 'scientific reform'. For example, the Russian Academy of Sciences is currently experiencing damage to its established structure that is unprecedented since its foundation in 1724 CE by Peter the Great (Gelfand 2013, Schiermeier 2013, 2015a, Yablokov 2014, Stone 2016). Moreover, the philanthropist Dmitry Zimin has recently fallen out of favour with the Kremlin (Schiermeier 2015b), and was thus forced by the Ministry of Justice to close his Dynasty Foundation (Kondrashov et al. 2015) — the nation's first private science-funding organization that was finally labelled a 'foreign agent' by the Russian government (Pokrovsky 2015).

These situations are symptomatic of the present instability in the world's largest country, with wide-ranging consequences. Inflating bureaucracy, politi-

cal conflicts of interest and a marked tendency towards 'climate-change scepticism', in tandem with meaningless formalism as well as an increase in pseudoscience and pseudoscientific project mongering, are triggering a new wave of scientific emigration from Russia (Schiermeier 2014), mainly among the youngest and most talented scholars. If this continues, this trend will further reduce the quantity and quality of internationally peer-reviewed publications with Russian contributions — last year Russia published approximately the same number of scholarly papers as Iran (Stone 2016).

It cannot be denied that Russia has made positive commitments, with regard to the 'Paris Agreement on Climate Change' in December 2015, to keep the global temperature rise at <2°C until 2100, and has also recently improved the country's grant system via the Russian Foundation for Basic Research, the new Russian Science Foundation, and via the most recent approval of the next round (no. 5) of 'mega grants' by the Director of the Department of Science and Technologies of the Ministry of Education and Science of the Russian Federation (11 March 2016). Neverthe-

*Corresponding author: buentgen@wsl.ch

less, it is alarming that the President's Scientific Council just announced a further reduction of the number of research institutions (often via combining several institutions) from around 1000 to approximately 150 (Stone 2016).

Although less severe and difficult to compare, the current situation in Russia is somehow similar to the turmoil that occurred just after the transformation of the Soviet Union, when funding was exceptionally low. At that time, Russian scholars had to either leave the country or increase their collaborations with western partners. A prime example of successful international partnership was the first upsurge of Russian tree-ring research in the 1990s (Briffa et al. 1998a, 1998b, Vaganov et al. 1999). Russia's current political and economic instability once more calls for global community support and transnational funding, superimposed on a solid background of trust. More than coincidentally,

the global oil price was at its record low when the Soviet Union collapsed, and is now, after a long-term high, again dramatically dwindling (Fig. 1).

Despite potential caveats, I advocate a twofold action plan: first, to launch and enhance international and interdisciplinary research collaborations with Russia; second, to establish new and maintain existing educational programs and scientific infrastructure in the world's largest country.

2. RESEARCH FOCI

Environmental changes not only generate a wide range of scientific questions and associated tasks, but also offer ample research opportunities between Russia and the international community. Joining forces appears particularly timely in light of Russia's

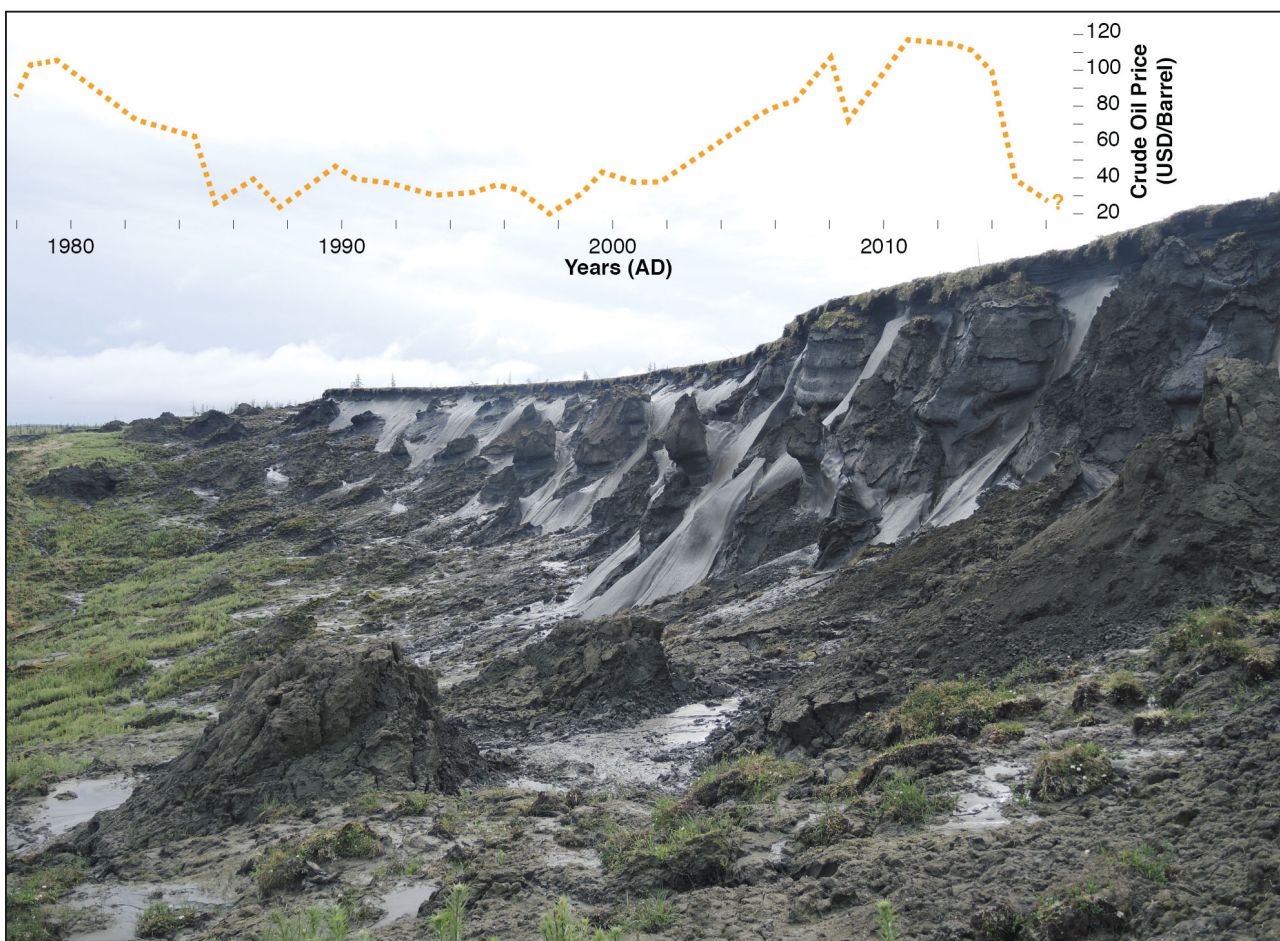


Fig. 1. Permafrost thawing along the Yana River in northeastern Siberia (70° N, 135° E) emphasizes the severity of recent global warming, and also stresses the urgent necessity for prompt scientific endeavour. Safeguarding unique plant and animal macrofossils released from thawing ice wedges requires state-of-the-art research skills and infrastructure, together with adequate funding schemes, which can only be achieved by strong international alliances. Inset reveals long-term fluctuations of the global oil price, with record lows in the 1980s, before the collapse of the Soviet Union, and again in 2016

ongoing economic crisis and political upheavals (Stone 2016), as well as the forecast rate of climate change (IPCC 2014). Understanding the effects of past, present and predicted temperature and precipitation variability on natural and human systems requires long-term and cross-disciplinary scientific investigations (Büntgen & Di Cosmo 2016, Büntgen et al. 2016). Apart from historical and future time scales, the recent warming trend across the high-northern latitudes seems unprecedented (IPCC 2014). Rapidly rising temperatures not only result in sea-ice reduction, Arctic greening and permafrost thawing (Fig. 1), but also influence river runoff, vegetation dynamics, species composition and unexpected disease revivals, such as the most recent anthrax outbreak in northwestern Siberia. These changes have implications not only for ecosystem services and the global carbon cycle (Gauthier et al. 2015), but also for human and animal health, for instance. At the same time, depopulation and reforestation across large fractions of the agriculturally valuable parts of western Russia cause social and biological challenges, respectively, with hydroclimatic regime shifts further affecting ecosystem functioning and productivity.

Geographical foci, in addition to the boreal taiga (Hellmann et al. 2016), sub-Arctic tundra and Arctic ecosystems, are mountainous biodiversity hotspots such as the Altai Mountains and the Caucasus region that have both experienced glacier retreats in recent decades (Solomina et al. 2016). The Baikal region and the Kamchatka peninsula, as well as the Lena delta, represent ideal locations for cross-disciplinary evaluations of various terrestrial, as well as aquatic and/or marine processes across a wide range of spatiotemporal scales (Büntgen et al. 2014, Meyer et al. 2015). Large parts of Siberia comprise exclusive permafrost sites, where remains of ancient humans and animals can be found, together with plant macrofossils (Pitulko et al. 2016b). Eastern Siberia still offers ample unexplored landscapes (Fig. 1), with Beringia being particularly important for testing the 'standstill hypothesis' (Hoffecker et al. 2014, 2016), as well as for researching conditions of the ancient 'mammoth flora and fauna' (Pitulko et al. 2016a), and Lake El'gygytyn representing a unique paleo-archive (Melles et al. 2012). Moreover, the vast expanse of the Russian landscape allows standardized research protocols to be conducted along extensive latitudinal and longitudinal gradients. Thus any serious assessment at the scale of the northern hemisphere or even globally depends on free data access from Russia, be it meteorological measurements or any other kind of environmental recording.

3. STRUCTURAL REQUIREMENTS

Outreach-oriented endeavours, as well as the establishment of a sustainable research infrastructure, should supplement my scientific recommendations. Encouraging interdisciplinary approaches to address timely subjects will generate high-impact publications and/or help obtain lucrative grants. Contributions from eastern and western partners should be carefully balanced with respect to funding, scientific content, and logistical and administrative obligations. International summer schools and field weeks in Russia should be organized and attended by the best lecturers and students from all over the world. Bilateral educational programs for the next generation of Russian scientists should involve PhD and post doc exchange programs, as well as open-access data portals and information forums. Infrastructure investments should include the establishment of long-term monitoring programs, and support for state-of-the-art laboratories and field stations. Nevertheless, most, if not all, of the suggested mid-to large-scale initiatives will require some official approval, and possibly even direct involvement of high-level officials, which might not always be easy to achieve (Nature 2015). Moreover, adequate financing of the necessary programs appears to be difficult (Kondrashov et al. 2015), because many international funding agencies require matching contributions from the Russian side, and the scientific budgets of the Russian Foundation for Basic Research and the Russian Science Foundation are steadily decreasing. Another non-trivial task is the introduction of western scientists to the conventions of Russia's political system. This and related aspects require respectful handling at eye level to best achieve common goals. While scientific interests should always be of the upmost importance, any kind of political and/or economic manipulation must be prohibited.

4. CONCLUSIONS

Like a bridge over troubled water, climate and environmental changes not only open up a wide range of research questions and tasks, but also call for new scientific alliances between Russia and the international community. To mitigate the dramatic deterioration of the Russian Academy of Sciences, to stop the ongoing brain drain and to facilitate access to excellent paleo-archives, global partnerships are urgently needed.

Acknowledgements. Alexander Kirdyanov was instrumental in stimulating this discussion. Olga Solomina, from the Department of Geography within the Russian Academy of Sciences in Moscow, Quirin Schiermeier, German Correspondent of Nature in Munich, as well as 2 anonymous referees kindly provided feedback on earlier versions of this manuscript. I received funding from the Ministry of Education, Youth and Sports of the Czech Republic within the National Sustainability Program I (NPU I), grant number LO1415. This study partly resulted from the interdisciplinary and international framework of the PAGES Euro-Med 2k project.

LITERATURE CITED

- Briffa KR, Schweingruber FH, Jones PD, Osborn TJ, Shiyatov SG, Vaganov EA (1998a) Reduced sensitivity of recent tree-growth to temperature at high northern latitudes. *Nature* 391:678–682
- Briffa KR, Jones PD, Schweingruber FH, Osborn TJ (1998b) Influence of volcanic eruptions on Northern Hemisphere summer temperature over the past 600 years. *Nature* 393:450–455
- Büntgen U, Di Cosmo N (2016) Climatic and environmental aspects of the Mongol withdrawal from Hungary in 1242 CE. *Sci Rep* 6:25606
- Büntgen U, Kirdyanov AV, Hellmann L, Nikolayev A, Tegel W (2014) Cruising an archive: on the palaeoclimatic value of the Lena Delta. *Holocene* 24:627–630
- Büntgen U, Myglan VS, Charpentier Ljungqvist F, McCormick M and others (2016) Cooling and societal change during the Late Antique Little Ice Age from 536 to around 660 AD. *Nat Geosci* 9:231–236
- Gauthier S, Bernier P, Kuuluvainen T, Shvidenko AZ, Schepaschenko DG (2015) Boreal forest health and global change. *Science* 349:819–822
- Gelfand M (2013) What is to be done about Russian science? *Nature* 500:379
- Hellmann L, Agafonov L, Charpentier Ljungqvist F, Churakova (Sidorova) O, and others (2016) Diverse growth trends and climate responses across Eurasia's boreal forest. *Environ Res Lett* 11:074021
- Hoffecker JF, Elias SA, O'Rourke DH (2014) Out of Beringia? *Science* 343:979–980
- Hoffecker JF, Elias SA, O'Rourke DH, Scott GR, Bigelow NH (2016) Beringia and the global dispersal of modern humans. *Evol Anthropol* 25:64–78
- IPCC (2014) Climate Change 2014: synthesis report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. IPCC, Geneva, Switzerland, 151 pp.
- Kondrashov FA, Kondrashov AS, Gelfand MS (2015) Russian science loses to politics. *Nature* 522:419
- Melles M, Brigham-Grette J, Minyuk PS, Nowaczyk NR and others (2012) 2.8 million years of arctic climate change from Lake El'gygytgyn, NE Russia. *Science* 337:315–320
- Meyer H, Opel T, Laepple T, Dereviagin AY, Hoffmann K, Werner M (2015) Long-term winter warming trend in the Siberian Arctic during the mid- to late Holocene. *Nat Geosci* 8:122–125
- Nature (2015) Russian roulette. *Nature* 526:475
- Pitulko VV, Pavlova EY, Basilyan AE (2016a) Mass accumulations of mammoth (mammoth 'graveyards') with indications of past human activity in the northern Yana-Indighirka lowland, Arctic Siberia. *Quat Int* 406:202–217
- Pitulko VV, Tikhonov AN, Pavlova EY, Nikolskiy PA, Kuper KE, Polozov RN (2016b) Early human presence in the Arctic: evidence from 45 000-year-old mammoth remains. *Science* 351:260–263
- Pokrovsky V (2015) Russia targets Western ties. *Science* 349:224–225
- Schiermeier Q (2013) Russian academy awaits new head. *Nature* 497:420–421
- Schiermeier Q (2014) Putin's Russia divides scientists. *Nature* 516:298–299
- Schiermeier Q (2015a) Russian science minister explains radical restructure. *Nature*, doi:10.1038/nature.2015.16776
- Schiermeier Q (2015b) Russia turns screw on science foundation. *Nature* 521:273
- Solomina O, Bushueva I, Dolgova E, Jomelli V, Alexandrin M, Mikhalevko V, Matskovsky V (2016) Glacier variations in the Northern Caucasus compared to climatic reconstructions over the past millennium. *Global Planet Change* 140:28–58
- Stone R (2016) Only the strong survive. *Science* 352:134–138
- Vaganov EA, Hughes MK, Kirdyanov AV, Schweingruber FH, Silkin PP (1999) Influence of snowfall and melt timing on tree growth in subarctic Eurasia. *Nature* 400:149–151
- Yablokov A (2014) Academy 'reform' is stifling Russian science. *Nature* 511:7

Editorial responsibility: Nils Chr. Stenseth, Oslo, Norway

*Submitted: June 1, 2016; Accepted: August 15, 2016
Proofs received from author(s): September 13, 2016*